CLAIMS

1. A method of producing a reflector which exhibits high omnidirectional reflection for a predetermined range of frequencies of incident electromagnetic energy for any angle of incidence and any polarization, comprising:

configuring a structure with a surface and a refractive index variation along the direction perpendicular to said surface while remaining nearly uniform along the surface, said structure configured such that

i) a range of frequencies exists defining a photonic band gap for electromagnetic energy incident along the perpendicular direction of said surface,

ii) a range of frequencies exists defining a photonic band gap for electromagnetic energy incident along a direction approximately 90° from the perpendicular direction of said surface, and

iii) a range of frequencies exists which is common to both of said photonic band gaps.

2. The method of claim 1, wherein step iii) comprises a range of maximum frequencies that exists in common to both of said photonic band gaps.

3. The method of claim 1, wherein ranges of frequencies exist defining photonic band gaps for electromagnetic energy incident along directions between 0° and approximately 90° from the perpendicular direction of said surface.

4. The method of claim 1, wherein said structure is configured as a photonic crystal.

5. The method of claim 4, wherein said structure is configured as a one dimensionally periodic dielectric structure.

6. The method of claim 4, wherein said periodic dielectric structure comprises periodic units each having two or more layers.

7. The method of claim 6, wherein said periodic units comprise layers of silicon and silicon dioxide.

8. The method of claim 6, wherein said periodic units comprise layers of GaAs and Al_xO_y.

9. The method of claim 6, wherein the zone for high omnidirectional reflection is

$$\frac{\Delta\omega}{2c} = \frac{a\cos\left(-\sqrt{\frac{A-2}{A+2}}\right)}{d_1 n_1 + d_2 n_2} - \frac{a\cos\left(-\sqrt{\frac{B-2}{B+2}}\right)}{d_1\sqrt{n_1^{\,2}-1} + d_2\sqrt{n_2^{\,2}-1}}$$

where

$$A \equiv \frac{n_2}{n_1} + \frac{n_1}{n_2}, \qquad B \equiv \frac{n_2\sqrt{n_1^{\,2}-1}}{n_1\sqrt{n_2^{\,2}-1}} + \frac{n_1\sqrt{n_2^{\,2}-1}}{n_2\sqrt{n_1^{\,2}-1}}.$$

10. The method of claim 6, wherein the layer thickness of materials of first and second layers with respective indices of refraction defined with respect to the ambient are chosen such that $\Delta\omega$ is greater than zero.

11. The method of claim 1, wherein said structure is configured with a continuous variation in refractive index.

12. The method of claim 1, wherein said structure is configured as an aperiodic dielectric structure.

13. The method of claim 1, wherein said reflector exhibits greater than 99% reflectivity.

14. A high omnidirectional reflector which exhibits reflection for a predetermined range of frequencies of incident electromagnetic energy for any angle of incidence and any polarization, comprising:

a structure with a surface and a refractive index variation along the direction perpendicular to said surface while remaining nearly uniform along the surface, said structure configured such that

i) a range of frequencies exists defining a photonic band gap for electromagnetic energy incident along the perpendicular direction of said surface,

ii) a range of frequencies exists defining a photonic band gap for

electromagnetic energy incident along a direction approximately 90° from the perpendicular direction of said surface, and

iii) a range of frequencies exists which is common to both of said photonic band gaps.

15. The method of claim 14, wherein item iii) comprises a range of maximum frequencies that exists in common to both of said photonic band gaps.

16. The reflector of claim 14, wherein ranges of frequencies exist defining photonic band gaps for electromagnetic energy incident along directions between 0° and approximately 90° from the perpendicular direction of said surface.

17. The reflector of claim 14, wherein said structure is configured as a photonic crystal.

18. The reflector of claim 17, wherein said structure is configured as a one dimensionally periodic dielectric structure.

19. The reflector of claim 17, wherein said periodic dielectric structure comprises periodic units each having two or more layers.

20. The reflector of claim 19, wherein said periodic units comprise layers of silicon

and silicon dioxide.

21. The reflector of claim 19, wherein said periodic units comprise layers of GaAs and Al_xO_y.

22. The reflector of claim 19, wherein the zone for high omnidirectional reflection is

$$\frac{\Delta\omega}{2c} = \frac{a\cos\left(-\sqrt{\frac{A-2}{A+2}}\right)}{d_1 n_1 + d_2 n_2} - \frac{a\cos\left(-\sqrt{\frac{B-2}{B+2}}\right)}{d_1\sqrt{n_1^{\,2}-1} + d_2\sqrt{n_2^{\,2}-1}}$$

where

$$A \equiv \frac{n_2}{n_1} + \frac{n_1}{n_2}, \qquad B \equiv \frac{n_2\sqrt{n_1^{\,2}-1}}{n_1\sqrt{n_2^{\,2}-1}} + \frac{n_1\sqrt{n_2^{\,2}-1}}{n_2\sqrt{n_1^{\,2}-1}}.$$

23. The reflector of claim 19, wherein the layer thickness of materials of first and second layers with respective indices of refraction defined with respect to the ambient are chosen such that $\Delta\omega$ is greater than zero.

24. The method of claim 14, wherein said structure is configured with a continuous variation in refractive index.

25. The method of claim 14, wherein said structure is configured as an aperiodic

dielectric structure.

26. The method of claim 14, wherein said reflector exhibits greater than 99% reflectivity.

27. A method of creating high omnidirectional reflection for a predetermined range of frequencies of incident electromagnetic energy for any angle of incidence and any polarization, comprising:

providing a structure with a surface and a refractive index variation along the direction perpendicular to said surface while remaining nearly uniform along the surface, said structure configured such that

i) a range of frequencies exists defining a photonic band gap for electromagnetic energy incident along the perpendicular direction of said surface,

ii) a range of frequencies exists defining a photonic band gap for electromagnetic energy incident along a direction approximately 90° from the perpendicular direction of said surface, and

iii) a range of frequencies exists which is common to both of said photonic band gaps.

28. The method of claim 27, wherein item iii) comprises a range of maximum frequencies that exists in common to both of said photonic band gaps .

29. The method of claim 27, wherein ranges of frequencies exist defining photonic band gaps for electromagnetic energy incident along directions between 0° and approximately 90° from the perpendicular direction of said surface.

30. The method of claim 27, wherein said structure is configured as a photonic crystal.

31. The method of claim 30, wherein said structure is configured as a one dimensionally periodic dielectric structure.

32. The method of claim 30, wherein said periodic dielectric structure comprises periodic units each having two or more layers.

33. The method of claim 32, wherein said periodic units comprise layers of silicon and silicon dioxide.

34. The method of claim 32, wherein said periodic units comprise layers of GaAs and Al_xO_y.

35. The method of claim 32, wherein the zone for high omnidirectional reflection is

$$\frac{\Delta\omega}{2c} = \frac{a\cos\left(-\sqrt{\frac{A-2}{A+2}}\right)}{d_1 n_1 + d_2 n_2} - \frac{a\cos\left(-\sqrt{\frac{B-2}{B+2}}\right)}{d_1\sqrt{n_1^2-1} + d_2\sqrt{n_2^2-1}}$$

where

$$A \equiv \frac{n_2}{n_1} + \frac{n_1}{n_2}, \qquad B \equiv \frac{n_2\sqrt{n_1^{\,2}-1}}{n_1\sqrt{n_2^{\,2}-1}} + \frac{n_1\sqrt{n_2^{\,2}-1}}{n_2\sqrt{n_1^{\,2}-1}}.$$

36. The method of claim 32, wherein the layer thickness of materials of first and second layers with respective indices of refraction defined with respect to the ambient are chosen such that $\Delta\omega$ is greater than zero.

37. The method of claim 27, wherein said structure is configured with a continuous variation in refractive index.

38. The method of claim 27, wherein said structure is configured as an aperiodic dielectric structure.

39. The method of claim 27, wherein the omnidirectional achieved is greater than 99%.

40. A method for producing an all dielectric omnidirectional reflector which exhibits omnidirectional reflection that is greater than 95% for a predetermined range of frequencies of incident electromagnetic energy of any angle of incidence and any polarization comprising:

providing a structure with a surface and a refractive index variation along the direction perpendicular to the said surface while remaining nearly uniform along the surface said surface

configured such that

(i) a range of frequencies exists defining a reflectivity range which is higher than 99% for EM energy incident along the perpendicular direction of the said surface,

(ii) a range of frequencies exists defining a reflectivity range which is higher than 99% for EM energy incident a direction approximately 90° from the perpendicular direction of the said surface, and

(iii) a range of frequencies exists which is common to both of said reflectivity ranges.

41. The method of claim 40, wherein the reflectivity is greater than 96%

42. The method of claim 40, wherein the reflectivity is greater than 97%

43. The method of claim 40, wherein the reflectivity is greater than 98%

44. The method of claim 40, wherein the reflectivity is greater than 99%

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